AORTIC CANNULA

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Patent Application No. 60/463,717, filed April 17, 2003 and incorporates that application by reference.

BACKGROUND OF THE INVENTION

[0001] During heart bypass surgery, it is necessary to direct oxygenated blood from the heart-lung machine into the aorta through an aortic cannula. Aortic cannulas are generally tubular structures with a diameter of about 7 to 8 mm which must deliver blood at the rate of about 5 to 6 liters per minute. It is important that the blood emerging into the aorta not scour the walls of the aorta dislodging material from the walls of the aorta causing embolisms. Moreover, the blood itself is fragile and may be damaged by stress caused by turbulence.

[0002] Any number of designs for aortic cannulas have been patented. However, little attention has been given to protection of the blood and insuring that the flow of the blood into the aorta is at as low a velocity as consistent with the volume flow rate and the diameter of the cannula and as laminar as possible while in the cannula and when exiting from the cannula. Current cannula designs reduce flow velocity but at the cost of increased turbulence.

[0003] It is an object, according to this invention, to provide an improved aortic cannula that provides low velocity laminar flow as the blood emerges into the aorta.

SUMMARY OF THE INVENTION

[0004] Briefly, according to this invention, there is provided an aortic cannula having an elongate, generally tubular side wall defining a conduit with distal and proximal ends, the distal end being adapted for insertion into the aorta during heart surgery to provide blood to the aorta. The conduit is separated into plural elongate lumens having smooth uninterrupted side walls and substantially equal cross sections extending back from the distal end of the cannula such that the velocity of the blood flowing along the lumen will not change. It is further preferred that all lumens have substantially the same cross section so that the velocity of flow in each lumen is substantially identical. The interior walls of each lumen are curved to avoid sharp corners to avoid turbulence. The distal end is configured to permit substantially unrestricted axial flow out the distal end of the cannula from all lumens.

[0005] According to a preferred embodiment, at least three lumens spiral around each other near the distal end.

[0006] According to yet another embodiment of this invention, there is provided an aortic cannula having an elongate generally tubular side wall having distal and proximal ends. The

distal end is adapted for insertion in the aorta. The distal end supports a rounded rigid web across the opening in the end of the cannula which serves as a deflector when the distal end is being inserted. The distal end is configured to permit substantially unrestricted laminar flow. Preferably, at least a portion of the opening at the distal end faces radially outward of the tubular side wall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Further features and other objects and advantages will become clear from the following detailed description made with reference to the drawing in which:

[0008] Fig. 1 is a perspective view of an aortic cannula according to this invention;

[0002] Fig. 2 is a broken away side view of the aortic cannula shown in Fig. 1;

[0003] Fig. 3 is an end view of the aortic cannula shown in Fig. 1;

[0004] Fig. 4 is a section view taken along line IV-IV of Fig. 2; and

[0005] Fig. 5 is a broken away side view of an alternate embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] Referring to the drawings, there is shown the distal end of an aortic cannula 10 according to this invention. The cannula has a generally tubular side wall 11 which may be tens of centimeters long. The outside diameter of the side wall is about 8 to 10 millimeters. The distal end of the cannula narrows somewhat to form a tip 12 that has a rounded end 13 for enabling easy penetration into an opening cut in the wall of the aorta. The interior of the cannula is divided into a plurality of side-by-side lumens which extend back from the distal end. As shown in the drawing, there are three lumens 14a. 14b, and 14c. It is acceptable if the plural lumens open into a single lumen between the distal and the proximal end of the cannula. Each of the plural lumens has a substantially identical cross section and smooth uninterrupted walls that have no sharp changes in cross section.

[0010] It is preferred that the plural lumens have a substantially identical cross section end to end even as the cannula narrows at the distal end. This can be achieved by thinning the side wall and the walls separating the plural lumens at the distal end. The openings in the distal end out of the plural lumens must be at least as large as the cross section of the lumens. This enables the continued laminar flow out of the end of the cannula.

[0011] According to a preferred embodiment, the plural lumens spiral around each other especially near the distal end of the cannula. The spiraling of the lumens is the result of the helical shape of the walls separating the lumens within the cannula. Most preferably, the plural lumens spiral through at least 120 degrees. It is believed this will provide a slight spiraling motion to the blood emerging from the cannula which will assist in maintaining the

laminar flow as the blood enters the aorta. In an alternate embodiment as shown in Fig. 5, the plural lumens do not spiral.

[0012] The walls separating the conduit into plural elongate lumens at the distal end form a rigid rounded web which serves as a deflector when the cannula is being inserted. A portion of the openings at the distal end face radially outward of the tubular side wall. As shown in Fig. 1, the tubular side wall gradually narrows near the distal end and the area of the openings at the distal end is at least as great as the cross-sectional area of the interior of the tubular side wall prior to where it narrows. Fig. 5 illustrates an embodiment wherein the conduit is divided into lumens that do not rotate. The walls still form a rigid rounded web which serves as a deflector. Indeed, it would be advantageous in an aortic cannula which is not divided into plural lumens to provide the rigid round web at only the very distal end of the cannula.

[0013] The aortic cannula can be fabricated by the synthetic materials that are commonly used in the manufacture of sterile cannulas and catheters. Typically, the cannula would be formed by extrusion.

[0014] Having thus described my invention with the detail and particularity required by the Patent Laws, what is desired protected by Letters Patent is set forth in the following claims.